REMARKS/ARGUMENTS

The Examiner is thanked for the thorough examination and search of the subject.

Claims 92, 97, 99, 101, 104, 106-109, 118, 120-123, 125-129, 151, 152, 154 and 156-165 are pending; Claims 92, 120 and 151 have been currently amended; Claims 1-91, 93-96, 98, 100, 102, 103, 105, 110-117, 119, 124, 130-150, 153 and 155 have been canceled. No new matter is believed to have been added.

Response to Claim Rejections under 35 U.S.C. 103

Applicants respectfully traverse the rejections for at least the reasons set forth below.

Response to Claims 92, 97, 99, 101, 104, 106-109 and 118

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As currently amended, independent Claim 92 is recited below:

92. A chip package comprising:

a substrate comprising a first pad having a surface with a first region, a second region and a third region between said first and second regions, and a solder mask layer on said first and second regions, wherein a first opening in said solder mask layer is over said third region, and said third region is at a bottom of said first opening;

a silicon chip over said substrate, wherein said silicon chip comprises a second pad having a surface with a fourth region, a fifth region and a sixth region between said fourth and fifth regions and over said third region, and a passivation layer on said fourth and fifth regions, wherein a second opening in said passivation layer is under said sixth region, and said sixth region is at a top of said second opening;

a copper pillar between said third region and said sixth region, wherein

said copper pillar is connected to said third region through said first opening and to said sixth region through said second opening, and wherein said second pad is connected to said first pad through said copper pillar;

a metal layer between said copper pillar and said sixth region, between said copper pillar and said passivation layer, between said copper pillar and said fourth region, and between said copper pillar and said fifth region, wherein said copper pillar is connected to said sixth region through said metal layer; and

a tin-containing layer between said copper pillar and said third region, wherein said copper pillar is connected to said third region through said tin-containing layer, wherein said tin-containing layer comprises silver, and wherein said tin-containing layer has a first thickness less than a second thickness of said copper pillar.

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Reconsiderations of Claims 92, 97, 101, 104, 106, 107, 109 and 118 rejected under 35 U.S.C. 103(a) as being unpatentable over Morrell (U.S. Pat. No. 6,013,571) in view of Ohuchi (U.S. Pub. No. 2002/0033525), of Claim 99 rejected under 35 U.S.C. 103(a) as being unpatentable over Morrell in view of Ohuchi, further in view of Hozoji et al. (U.S. Pub. No. 2002/0079575) and of Claim 108 rejected under 35 U.S.C. 103(a) as being unpatentable over Morrell in view of Ohuchi, further in view of Fang (U.S. Pub. No. 2002/0095784) are requested based on the following remarks.

Applicants respectfully assert that the chip package currently claimed in Claim 92 patentably distinguishes over the citations by Morrell (U.S. Pat. No. 6,013,571) in view of Ohuchi et al. (U.S. Pub. No. 2002/0033525).

The Examiner considers that "it would have been obvious to one of ordinary skill in the art to select either Sn/Ag as an alternate eutectic solder, since it has been held that the selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination." *~ See lines 2-5 on page 5, in the last Office Action mailed Nov. 26, 2008 ~*

Applicants respectfully traverse the Examiner's opinion because Ohuchi's solder 2 is believed to be non-analogous to Morrell's solder cap 30. Morrell teaches that an electroplating process is used to form a solder cap 30 over a copper pillar 24 in an opening 22 in a photoresist layer 18. ~ *See Fig. 1 and col. 3, lines 52-67, in U.S. Pat. No. 6,013,571* ~ However, Ohuchi only teaches that a tin-silver alloy can be used for a solder, but fails to teach, hint or suggest that the tin-silver alloy can be formed by an electroplating process. ~ *See Para. [0044] in U.S. Pub. No. 2002/0033525* ~ Therefore, even under Morrell's teaching in view of Ohuchi's teaching, one of ordinary skill in the art would not come up with that an electroplating process can be used to form a tin-silver alloy over Morrell's copper pillar 24 because Ohuchi fails to teach, hint or suggest that a tin-silver alloy can be formed using an electroplating process.

Morrell's bonding structure with the subject matter that a solder joint 34 has a first thickness less than a second thickness of a copper pillar 24 is taught to be bonded on a pad of a substrate without a solder mask, and therefore the solder from the solder joint 34 may flow to the interface between a bond pad 32 and a substrate 14 along a sidewall of the bond pad 32, which leads Morrell's chip package with a bad reliability even though a solder mask not being formed causes a lower cost. Morrell seeks for production with a lower cost, but not for production with a better reliability.

Applicants teach that a substrate comprises a solder mask layer on first and second regions of a surface of a first pad of a substrate, wherein a first opening in the solder mask layer is over a third region of the surface between the first and second regions, as currently claimed in Claim 92. The substrate may avoid the above-mentioned problem because a solder joined with the first pad is difficult to flow to a bottom side of the first pad along a sidewall of the first pad due to the solder mask being formed on a surrounding region of the first pad. However, Morrell would not come up with the subject matter that the solder joint 34 may be joined with applicants' substrate because the design for applicants' substrate is against Morrell's objective of production with a lower cost, as shown in Fig. 4 in U.S. Pat. No. 6,013,571.

Withdrawal of rejection under 35 U.S.C. 103 (c) to Claim 92 is respectfully requested.

For at least the foregoing reasons, applicants respectfully submit independent Claim 92 patently distinguishes over the prior art references, and should be allowed. For at least the above reasons, dependent Claims 97, 99, 101, 104, 106-109 and 118 patently defines over the prior art as well.

Response to Claims 120-123, 125-129, 163 and 165

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As currently amended, independent Claim 120 is recited below:

120. A bonding structure on a chip comprising a pad having a top surface with a first region, a second region and a third region between said first and second regions, and a passivation layer on said first and second regions, wherein an opening in said passivation layer is over said third region, and said third region is at a bottom of said opening, comprising:

a metal layer on said third region, over said passivation layer and over said first and second regions, wherein said metal layer is connected to said third region through said opening;

a copper pillar on said metal layer, over said passivation layer and over said first, second and third regions, wherein said copper pillar is connected to said third region through said metal layer; and

a tin-containing cap over said copper pillar, wherein said tin-containing cap is connected to said third region through said copper pillar, wherein said tin-containing cap comprises silver, and wherein said tin-containing cap has a first thickness less than a second thickness of said copper pillar.

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Reconsiderations of Claims 120-123, 126-129 and 163 rejected under 35 U.S.C. 103(a) as being unpatentable over Morrell (U.S. Pat. No. 6,013,571) in view of Ohuchi (U.S. Pub. No. 2002/0033525), of Claim 165 rejected under 35 U.S.C. 103(a)

as being unpatentable over Morrell in view of Ohuchi, further in view of Hozoji et al. (U.S. Pub. No. 2002/0079575) and of Claim 125 rejected under 35 U.S.C. 103(a) as being unpatentable over Morrell in view of Ohuchi, further in view of Fang (U.S. Pub. No. 2002/0095784) are requested based on the following remarks.

Applicants respectfully assert that the bonding structure currently claimed in Claim 120 patentably distinguishes over the citations by Morrell (U.S. Pat. No. 6,013,571) in view of Ohuchi et al. (U.S. Pub. No. 2002/0033525).

The Examiner considers that "it would have been obvious to one of ordinary skill in the art to select either Sn/Ag as an alternate eutectic solder, since it has been held that the selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination." ~ *See lines 2-5 on page 5, in the last Office Action mailed Nov. 26, 2008* ~

Applicants respectfully traverse the Examiner's opinion because Ohuchi's solder 2 is believed to be non-analogous to Morrell's solder cap 30. Morrell teaches that an electroplating process is used to form a solder cap 30 over a copper pillar 24 in an opening 22 in a photoresist layer 18. ~ *See Fig. 1 and col. 3, lines 52-67, in U.S. Pat. No. 6,013,571* ~ However, Ohuchi only teaches that a tin-silver alloy can be used for a solder, but fails to teach, hint or suggest that the tin-silver alloy can be formed by an electroplating process. ~ *See Para. [0044] in U.S. Pub. No. 2002/0033525* ~ Therefore, even under Morrell's teaching in view of Ohuchi's teaching, one of ordinary skill in the art would not come up with that an electroplating process can be used to form a tin-silver alloy over Morrell's copper pillar 24 because Ohuchi fails to teach, hint or suggest that a tin-silver alloy can be formed using an electroplating process.

Withdrawal of rejection under 35 U.S.C. 103 (c) to Claim 120 is respectfully requested.

For at least the foregoing reasons, applicants respectfully submit independent

Claim 120 patently distinguishes over the prior art references, and should be allowed. For at least the above reasons, dependent Claims 121-123, 125-129, 163 and 165 patently defines over the prior art as well.

Response to Claims 151, 152, 154, 156-162 and 164

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As currently amended, independent Claim 151 is recited below:

151. A bonding structure on a chip comprising a pad having a top surface with a first region, a second region and a third region between said first and second regions, and a passivation layer on said first and second regions, wherein an opening in said passivation layer is over said third region, and said third region is at a bottom of said opening, comprising:

a metal layer on said third region, over said passivation layer and over said first and second regions, wherein said metal layer is connected to said third region through said opening;

a copper pillar on said metal layer, over said passivation layer and over said first, second and third regions, wherein said copper pillar is connected to said third region through said metal layer; and

a tin-containing cap over said copper pillar, wherein said tin-containing cap is connected to said third region through said copper pillar, wherein said tin-containing cap has a first thickness less than a second thickness of said copper pillar, and wherein said tin-containing cap has a greatest transverse dimension less than that of said copper pillar.

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Reconsiderations of Claims 151, 152, 154, 157, 159-162 and 164 rejected under 35 U.S.C. 103(a) as being unpatentable over Morrell (U.S. Pat. No. 6,013,571), of Claim 156 rejected under 35 U.S.C. 103(a) as being unpatentable over Morrell in view of Fang (U.S. Pub. No. 2002/0095784) and of Claim 158 rejected under 35 U.S.C. 103(a) as being unpatentable over Morrell in view of Hozoji et al. (U.S. Pub. No. 2002/0079575) are requested based on the following remarks.

Applicants respectfully assert that the bonding structure currently claimed in Claim 151 patentably distinguishes over the citations by Morrell (U.S. Pat. No. 6,013,571).

In response to point 23 on page 8 in the last Office Action mailed Nov. 26, 2008, the claimed subject matter that a tin-containing cap has a greatest transverse dimension less than that of a copper pillar under the tin-containing cap, as currently claimed in Claim 151, could have the tin-containing cap to be easily lowered into an opening in an insulating layer and to be joined with a pad exposed by the opening, as taught in Fig. 5B and in paragraph [0044] in the original specification, which is not anticipated by Morrell. Therefore, the selected dimension is for a particular unobvious purpose and produces an unexpected result. The claimed subject matter that a tin-containing cap has a greatest transverse dimension less than that of a copper pillar under the tin-containing cap, as currently claimed in Claim 151 would have been unobvious to one of ordinary skill in the art, since Morrell fails to anticipate the above-mentioned advantage.

Withdrawal of rejection under 35 U.S.C. 103 (c) to Claim 151 is respectfully requested.

For at least the foregoing reasons, applicants respectfully submit independent Claim 151 patently distinguishes over the prior art references, and should be allowed. For at least the above reasons, dependent Claims 152, 154, 156-162 and 164 patently defines over the prior art as well.

Conclusion

Some or all of the pending claims are believed to be in condition for allowance. Accordingly, allowance of the claims and the application as a whole are respectfully requested.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Sincerely yours,

/Winston Hsu/ Date: 02/25/2009

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Note: Please leave a message in my voice mail if you need to talk to me. (The time in D.C. is 13 hours behind the Taiwan time, i.e. 9 AM in D.C. = 10 PM in Taiwan.)